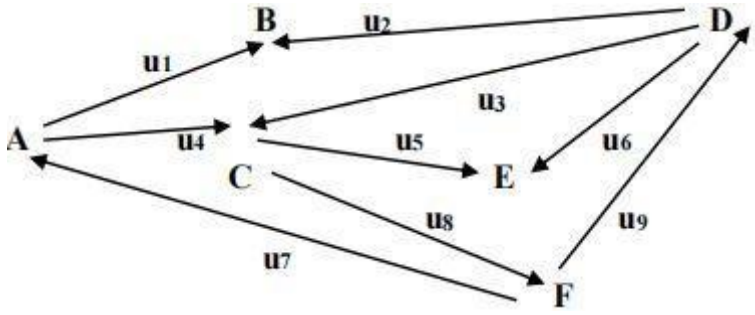
الجمهـــوريـــــة الجزائريـــــة الديمـقـراطيـــــة الشعبيـــــة People`s Democratic Republic of Algeria		
Ministry of Higher Education and Scientific Research National School of Cyber Security	NSCS المدرسة الوطنية العليا في الأمن السيبراني NATIONAL SCHOOL OF CYBERSECURITY	وزارة التعليـم العـالـي والـبحـث العـلـمي المدرسـة الوطنيـة العليـا في الأمن السيبراني
Foundation Training Department		قسـم التكويـن القـاعدي
LEVEL : 1st Year Basic Training	Tutorial Sheet No. 1	MODULE : Graph Theory

Exercise1:

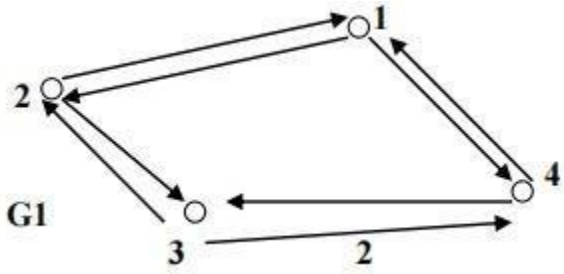
1) Let G = (X,U) be a directed graph with X = { 1,2,3,4,5,6 } and the arcs:u1=(1,2);u2=(2,3);u3=(4,3); u4=(6,4);u5=(6,5);u6=(5,1);u7=(2.5);u8=(4,2);u9=(3.5)andu10=(5.4).
   a) Plot the graph G.
   b) Find the degree of each vertex.
   c) Give an example of a circuit.
2) Let the graph G' as bellow:

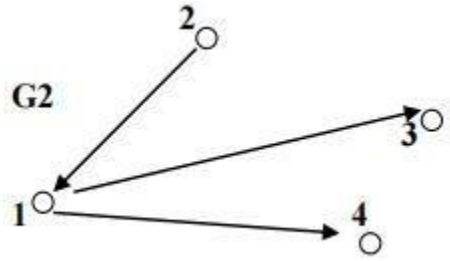


   a) Is the path: {(AC),(CF),(FD),(DC),(CE)} an elementary path?
   b) Is the path: {(AC),(CF),(FA),(AC),(CE)} a simple path?
3) From the graph G':
   a) Draw its equivalent undirected graph G"=(X,U) with X={A,B,C,D,E,F} and edges u1; u2; u3; u4; u5; u6; u7; u8 and u9.
   b) Find the degree of each vertex.
   c) Give an example of a cycle.
   d) Is the chain:{u4 u5 u6 u9 u8 u4}an elementary chain?
   e) Is the chain:{u1 u2 u3 u4 u7}a simple chain?

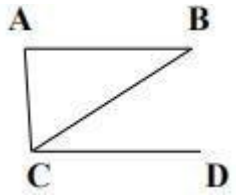
Exercise2:

1) What is the nature of each graph?

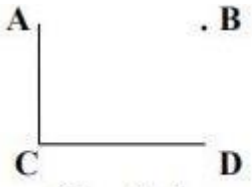




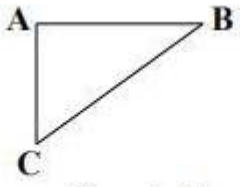
2) Let the undirected graph G be:



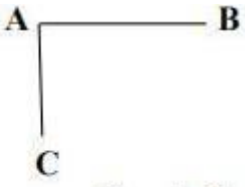
What is the nature of each of the following graphs extracted from G?



Graphe1



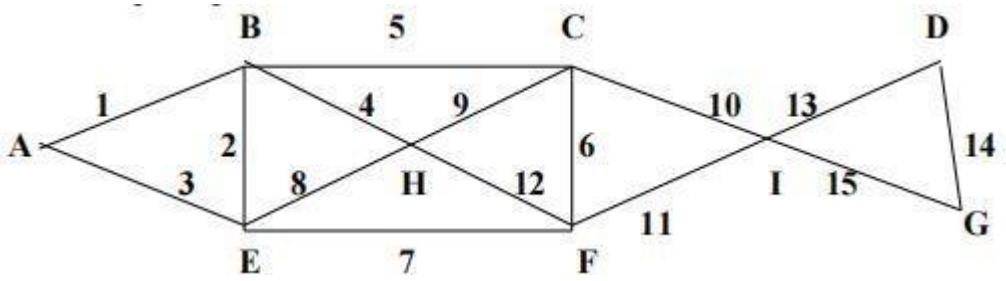
Graphe2



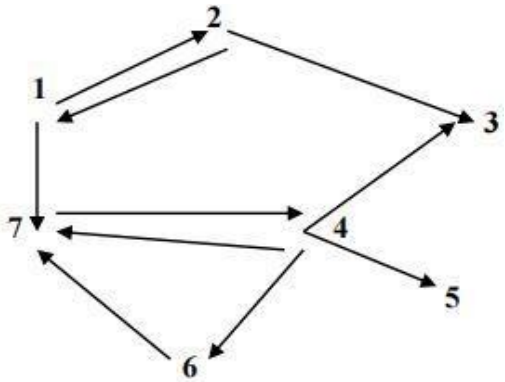
Graphe3

Exercise3:

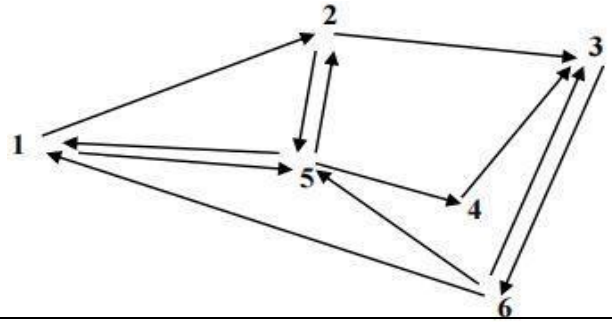
1. Does the following graph admit an Eulerian cycle? If yes, say why and find one?



2. Does the following graph have a Hamiltonian path?



3. Find at least one path and one Hamiltonian circuit in the following graph G':



Exercise4:

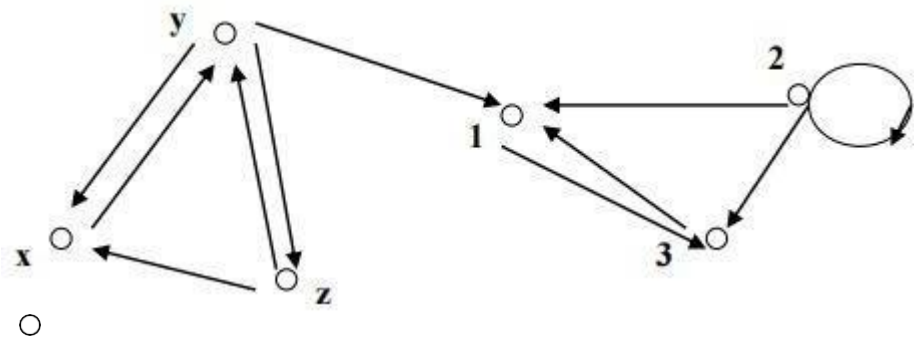
Let G be an undirected graph of order 10 having 22 edges. It has exactly 5 vertices of degree 3, the others are of degree 4 or 7. How many vertices of degree 4 are there?

Exercise5:

1. What is the number of edges of a complete undirected graph G= (X, U) with|X|=n and |U|=m?

Exercise6:

1. Is the following graph a strongly connected graph?



2. Find a reduced graph
3. Show that an undirected, loop-free graph with **n** number of vertices and having more than **(n-1)(n-2)/2 edges** is connected.

Exercise7:

1. Propose three different data structures that can be used to represent a graph in a computer's memory.
2. Application to the following graph